AMENDMENTS TO THE CLAIMS

The following is a complete, marked up listing of revised claims with a status identifier in parentheses, underlined text indicating insertions, and strikethrough and/or double-bracketed text indicating deletions.

Claims:

1. (Currently Amended) An absolute position rotary encoding apparatus comprising:

a disk having a first code track and a second code track formed [[thereon]] on said disk;

a light source for illuminating said code tracks;

[[an]] a first area array sensor configured to receive the light illuminating said code tracks for [[imaging]] forming an imaged pattern of a portion of said first and second code tracks simultaneously, said area array sensor capable of imaging onto a pixel matrix having a plurality of rows;

[means for]] a first detector reading a first detector line corresponding to a row in the pixel matrix comprising the first code track;

[means for]] a second detector reading a second detector line corresponding to a row in the pixel matrix comprising the second code track; and

[[means for]] a processor compensating for fluctuations in the code [[track]] tracks resulting from the disk being inaccurately mounted, by [[selecting a suitable line imaged by]] shifting one of said detector lines on the first area array sensor being read, such that [[the]] a period length of the imaged pattern of the code tracks matches [[the]] a period length used in the position calculation[[;]] and [[processing means]] for numerically calculating an absolute position based on the imaged code tracks from the disk.

2. (Currently Amended) An encoding apparatus according to claim 1, wherein the [[scale element]] disk is an optical disk suitable for use in a rotary encoder and the first code track represents the incremental track and the second code track represents the absolute track.

3. (Original) An encoding apparatus according to claim 1, wherein said light source is a photoemitter such as an LED, laser diode, or incandescent light source.

4. (Original) An encoding apparatus according to claim 1, wherein the area array sensor is constructed of either CCD or CMOS photodiode technology.

5. (Currently Amended) An encoding apparatus according to claim 1, wherein said light source and said first area array sensor are proximally located on a first side of the [[scale element]] disk and a mirror located on a second side, whereby the emitted light is reflected by the mirror through the [[scale element]] disk to illuminate the code tracks for reception by the first area array sensor.

6. (Currently Amended) An encoding apparatus according to claim 1, wherein the [[processing means further]] processor includes a Field Programmable Gate Array (FPGA) logic circuit for numerically calculating [[the]] phase intensity distribution, [[the]] spatial frequency and the phase angle of the [[image]] imaged pattern of the code tracks.

7. (Currently Amended) An encoding apparatus according to claim [[1]] 2, [[wherein at least two]] further comprising a second area array [[sensors]] sensor, where the first area array sensor and the second area array sensor are positioned 180 degrees apart with respect to the

optical disk, such that the incremental and absolute code tracks are read at two different locations resulting in two different angular positions, and wherein the absolute position is based on the mean of the angular positions.

8. (Original) An encoding apparatus according to claim 2, wherein the incremental track is comprised of a plurality of equally spaced and radially distributed markings near the outer edge of the disk, and wherein the absolute track is comprised of markings that form a series of coded lines that include broad and narrow lines radially distributed inside the incremental track such that the broad lines divide the track into equally sized sections and within each section are two narrow data lines that carry information about absolute position.

9. (Currently Amended) An encoding apparatus according to claim [[1]] 2, wherein the [[means for compensating include means for]] processor dynamically [[changing]] changes the detector line of the incremental track image, when the pattern period changes due to inaccurate mounting of the [[scale element]] optical disk which causes undesirable spatial movement of the code [[track]] tracks, so that the detector line is shifted so that [[it]] the detector line always includes an image with [[the same]] a constant pattern period.

10. (Currently Amended) An encoding apparatus according to claim 1, wherein the [[means for compensating include means for altering the]] processor alters a numerical value of the pattern period used in [[the]] a Fourier phase algorithm to match [[the]] a spatial frequency of fluctuating tracks.

11. (Currently Amended) An encoding apparatus according to claim [[1]] 2, [[wherein]] further comprising [[four]] third and fourth area array sensors are positioned 90 degrees apart with respect to the optical disk, such that the incremental and absolute code tracks are read at four different locations.

12. (Currently Amended) A Total Station theodolite apparatus used for topographic surveying and mapping includes an optical encoder for measuring angular position in the vertical plane and the horizontal plane and cooperates with a servo-mechanism for automatically tracking a target, [[wherein]] said encoder comprising:

an optical disk having an incremental code track and an absolute code track formed thereon;

a photoemitter light source for illuminating the incremental and absolute code tracks;

[[an]] a first area array sensor configured to receive the light illuminating said code tracks for [[imaging]] forming an imaged pattern of a portion of said incremental and absolute code tracks from the disk simultaneously, said first area array sensor being capable imaging onto a pixel matrix having a plurality of rows;

[[means for]] a first detector reading a first detector line corresponding to a row in the pixel matrix comprising the incremental track;

[[means for]] a second detector reading a second detector line corresponding to a row in the pixel matrix [[comprising]] including the absolute code track; and

[[means for]] a processor for compensating for a shifting code track resulting from inaccurate mounting of the disk by selecting a suitable line imaged by the area array sensor such that [[the]] a period length of the imaged pattern of the code tracks matches [[the]] a period length used in [[the]] a position calculation[[;]], [[processing means for]] calculating an absolute

position based on the imaged code tracks from the disk[[;]], and [[means for]] calculating [[the]] topographic data and tracking information about the target.

13. (Currently Amended) A Total Station apparatus according to claim 12, wherein the optical disk opaque with transparent <u>markings defining the incremental and absolute</u> code [[track]] <u>tracks</u> [[markings]] or a transparent disk with opaque <u>markings defining the incremental and absolute</u> code [[track markings]] <u>tracks</u>.

14. (Original) A Total Station apparatus according to claim 12, wherein the photoemitter is an LED, laser diode, or incandescent light source and the area array sensor is an Interline Transfer (ILT) CCD area array sensor.

15. (Currently Amended) A Total Station apparatus according to claim 12, wherein the [[processing means further]] <u>processor</u> includes a Field Programmable Gate Array (FPGA) logic circuit for numerically calculating the phase intensity distribution, the spatial frequency and the phase angle of the image of the code tracks.

16. (Currently Amended) A Total Station apparatus according to claim 12, [[wherein at least two]] <u>further comprising a second</u> area array [[sensors]] <u>sensor, wherein the first area array sensor and the second area array sensor</u> are positioned 180 degrees apart <u>with respect to the optical disk,</u> such that the incremental and absolute code tracks are read at two different locations resulting in two different angular positions, and wherein the absolute position is based on the mean of the angular positions.

17. (Original) A Total Station apparatus according to claim 12, wherein the incremental track is comprised of a plurality of equally spaced and radially distributed markings near the outer edge of the disk, and wherein the absolute track is comprised of markings that form a series of coded lines that include broad and narrow lines radially distributed inside the incremental track such that the broad lines divide the track into equally sized sections and within each section are two narrow data lines that carry information about absolute position.

18. (Currently Amended) A Total Station apparatus according to claim 12, wherein the [[calculating means is performed by a]] processor [[and]] includes a controller for operating the automatic tracking servo-mechanism.

19. (Currently Amended) A Total Station apparatus according to claim 12, wherein the [[means for compensating include means for]] processor dynamically [[changing]] changes the detector line of the incremental track image, when the pattern period changes due to spatial movement of the disk, so that the detector line is shifted so that [[it]] the detector line always includes an image with [[the same]] a constant pattern period.

20. (Currently Amended) A Total Station apparatus according to claim 12, wherein the [[means for compensating include means for altering the]] processor alters a numerical value of the pattern period used in [[the]] a Fourier phase algorithm to match [[the]] a spatial frequency of fluctuating tracks.

21. (Currently Amended) A method of calculating an absolute position with an optical rotary encoder device comprising [[the steps of]]:

illuminating with a light source an incremental code track and an absolute code track formed on a disk;

imaging a segment of the incremental and absolute code tracks onto a first CCD or CMOS area array sensor for forming an imaged pattern of the code tracks, wherein the segment is imaged onto a pixel matrix having a plurality of rows;

reading a first detector line corresponding to a row in the matrix comprising the incremental code track;

reading a second detector line corresponding to a row in the matrix comprising the absolute code track;

compensating for fluctuations in the code tracks resulting from inaccurate mounting of the disk by selecting a suitable line imaged by the first area array sensor such that [[the]] a period length of the imaged pattern of the code tracks matches [[the]] a period length used in [[the]] position calculation; and

calculating numerically the absolute position based on the light distribution of the [[images]] imaged patterns of the incremental and absolute code tracks.

22. (Currently Amended) The method according to claim 21, wherein the imaging uses [[at least two area array sensors are]] a second CCD or CMOS area array sensor, where the first and second area array sensors are positioned 180 degrees apart with respect to the optical disk, such that the incremental and absolute code tracks are read at two different locations resulting in two different angular positions, and wherein the absolute position is based on the mean of the angular positions.

23. (Currently Amended) The method according to claim 21, wherein said light source and said first and second area array [[sensor]] sensors are proximally located on a [[one]] first side of the [[scale element]] disk and a mirror located on [[the other]] a second side, whereby [[the]] emitted light is reflected by the mirror through the [[scale element]] disk to illuminate the code tracks for reception by the first and second area array sensors [[sensor]].

24. (Currently Amended) The method according to claim 21, wherein the compensating [[step]] dynamically changes the detector line of the incremental track image when the pattern period changes due to spatial movement of the disk, so that the detector line is shifted so that [[it]] the detector line always includes an image with [[the same]] a constant pattern period.

25. (Currently Amended) The method according to claim 21, wherein the compensating [[step]] includes altering the numerical value of the pattern period used in [[the]] a Fourier phase algorithm to match [[the]] spatial frequency of fluctuating tracks.

26. (Original) The method according to claim 21, wherein at least a Field Programmable Gate Array (FPGA) performs at least a portion of the numerical calculations.

27. (Currently Amended) The method according to claim 21, wherein the imaging uses second, third and fourth CCD or CMOS area array sensors, where the first through fourth area array sensors [[four area array sensors]] are positioned 90 degrees apart with respect to the disk, such that the incremental and absolute code tracks are read at four different locations.